IP for Smart Objects (IPSO)

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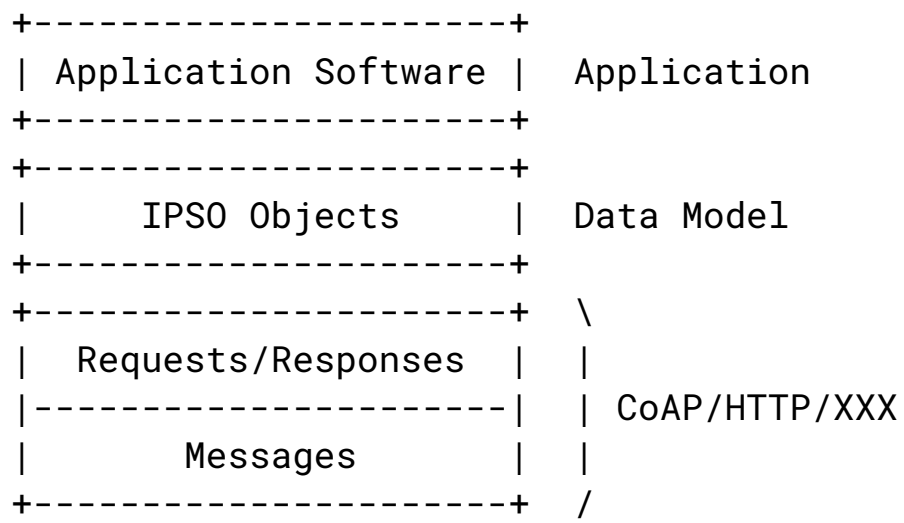
These slides are available at jaimejim.github.io

IPSO Architecture

- The specifications aims to create a set of objects and resources that represent:
  - Fundamental concepts (i.e. temperature, on/off switch)
  - Single points of those concepts (i.e. Min/Max Value, Current Value)
- Make those atomic pieces reusable accross domains.
- Make complex things by first aggregating those resources and then using composition.
- Intended for URIs, REST protocols. Model in XSD, Objects in XML, serialized in JSON/CBOR/TLV/Senml...



Data Model

Object Representation

- Simple URI template:

  ```
  Object ID/ Object Instance ID/ Resource ID.
  ```

  ```
  3300  -> Temperature Sensor
  0     -> instance 0 of a Temperature Sensor
  5700  -> resource having the current value or a most recent reading`
  ```

- All objects are registered with OMNA where the LWM2M Management Objects also are. We also use the IPSO Repository. More on that later.

Data Types

- Reuse those used by OMA LWM2M.
  - String, Integer, Float, Boolean, Object Link, Time, Opaque.

Data Model

Operations

- Same as OMA LWM2M.
  - R/W/X over resources, C/D over Instances, ...

Content Formats

- Specified by the OMA LW TS 1,0, JSON, CBOR and SenML:
  - Resources: text/plain, tlv. Objects: text/senml+json, application/cbor...

Application Protocol

- The data model is agnostic of the protocol itself.
- Observation is supported if the protocol supports it (e.g. CoAP Observe, SNMP Traps, MQTT subscribe...), so do other operations.

Sample Temperature Object

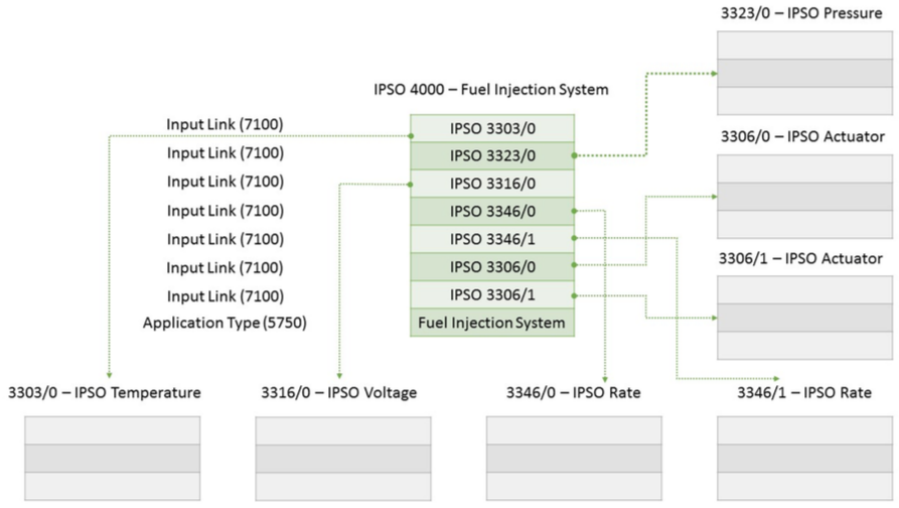
Object Name	ID	Instances	Object URN
Temperature Sensor	3303	Multiple	urn:oma:lwm2m:ext:3303

Resource	ID	Oper.	Mandatory	Type	Units	Description
Sensor Value	5700	R	Mandatory	Float	Defined by "Units" resource	Current measured sensor value
Min Measured Value	5601	R	Optional	Float	Defined by "Units" resource	The minimum value measured by the sensor since power ON
Max Measured Value	5602	R	Optional	Float	Defined by "Units" resource	The maximum value measured by the sensor since power ON
Min Range Value	5603	R	Optional	Float	Defined by "Units" resource	The minimum value that can be measured
Max Range Value	5604	R	Optional	Float	Defined by "Units" resource	The maximum value that can be measured
Sensor Units	5701	R	Optional	String		Measurement units definition e.g. "Cel" for celsius
Reset Min and Max Measured Values	5605	E	Optional	String		Reset the min and max measured values to current value

Composite Objects

- As devices increase in complexity we can construct more complex objects by using Object Links instead of adding resources. That offers more granularity than a large nested object would (by observing the linked objects instead of the main one).

IPSO Object	Real Sensor/Actuator
IPSO 3303 Temperature	ECT Sensor
IPSO 3316 Voltage	Throttle Position Sensor
IPSO 3316 Rate	Mass Airflow Sensor
IPSO 3346 Rate	Crankshaft Speed Sensor
IPSO 3323 Pressure	Fuel Pressure Sensor
IPSO 3306 Actuator	Fuel Injector
IPSO 3306 Actuator	Pump Valve



Reusability

- If the existing set of Objects is not sufficient for your needs, you can create your own by reusing existing resources.
- Current set of objects and resources can be found at: https://github.com/IPSO-Alliance/pub/tree/master/reg

Sample Implementations

- IPSO is supported by default by LWM2M, for example in Leshan.
- Sample C package for use of IPSO Objects in Contiki.
- JS code templates of IPSO-defined devices code templates. Each template gives a code snippet of how to initialize an *Object Instance* with its `oid` and `iid`, and lists every *Resource* the *Object Instance* **may** have.
- Sample Smart Objects Class that can be used to create IPSO Smart Objects in your JavaScript applications.
- BIPSO solves the probem of consistency and compatibility for BLE applications.

Repository

https://github.com/IPSO-Alliance/pub

- Issue tracker
- travis-ci
- XML-defined Objects

Q&A

What do you work on?

- Domain: IPSO Objects are generic in nature, both for the home or industrial domains.
- Coverage: Provide data model and basic semantics. No code generation, though third parties like BIPSO have automatic C code generation for the objects. I do basic validation on travis travis-ci

Q&A

How do you work?

- We did not have many contributors for v1. I believe vendors are using what's available on device distros (i.e. contiki, mbed, riot). IPSO repository is very open right now, easy to build upon.
- Traditionally both in IPSO and LWM2M work has been made through a committee. IMO that is necessary only when defining the basic semantics and particularities of a model. Once that's achieved, it's been mostly a collaborative and open approach through the public repository.
- Doing changes to the model, updates and enhancements is complicated cause it requires consensus and you end up with multiple versions.
- Adding new objects is trivial via a PR, we could add multiple validation/verification processes, comment oportunities, etc.

Q&A

How far did you get?

- V1 is on http://ipso-alliance.github.io/pub/, supports issue tracking, validation, etc.
- I'd like to have a collaborative approach, with more developer commitment, better validation and less overhead.

Q&A

How is your work prepared to be part of a larger picture?

- As far as the repository, it's Open Source at the moment and I think it is not a bad model as far as usage/processes are concerned.
- Lightweight coordination processes and more input from device manufacturer would be needed. For example, it was convenient to get feedback from the IKEA lights developer, Eclipse folks, etc.

Q&A

Opportunities for Collaboration

- Process is normal Open Source development.
- License is MIT
- Translation? Already work on translation LWM2M to YANG.
- Collaboration with smaller players preferable.

Q&A

How can Research contribute to the success of your work?

- Gaps in the technologies: takes time to add new features (i.e. data types), backwards compatibility will be problematic. At the moment it seems overspecified
- Simplicity and openness has seemed to be the key towards adoption.
- What's needed to integrate with some other effort?: IDK, seems more political than technical.